OIPE
MAR 29 2006
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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Confirmation No. 8229

Applicants	:	Allan Charles Webb, et al.
Serial No.	:	10/784,459
Filed	:	February 23, 2004
Title	:	COMPONENT ASSEMBLY WITH FORMED SPINDLE END PORTION
Group Art Unit	:	3682
Examiner	:	Lenard A. Footland
Attorney Docket No.	:	626220510021

TRANSMITTAL OF APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Appellant's Appeal Brief is attached in triplicate. Please charge the $500.00 fee and any additional fees to Deposit Account No. 501432 (Jones Day). A duplicate copy of this sheet is attached.

Respectfully submitted,

H. Duane Switzer

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OIPE IAP86 MAR 29 2006 PATENT & TRADEMARK OFFICE

PTO/SB/21 (09-04)
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TRANSMITTAL FORM

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Total Number of Pages in This Submission: 32

Application Number	10/784,459
Filing Date	February 23, 2004
First Named Inventor	Allan Charles Webb et al.
Art Unit	3682
Examiner Name	Lenard A. Footland
Attorney Docket Number	626220510021

ENCLOSURES *(Check all that apply)*

- [X] Fee Transmittal Form
  - [ ] Fee Attached
- [ ] Amendment/Reply
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
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- [ ] Express Abandonment Request
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- [ ] Certified Copy of Priority Document(s)
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- [ ] Drawing(s)
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Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	JONES DAY		
Signature	H Duane Switzer		
Printed name	H. Duane Switzer		
Date	March 27, 2006	Reg. No.	22431

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Typed or printed name	H. Duane Switzer	Date	March 27, 2006

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OIPE IAP66 MAR 29 2006 PATENT & TRADEMARK OFFICE

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Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).

FEE TRANSMITTAL For FY 2006

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($)

Complete if Known	
Application Number	10/784,459
Filing Date	February 23, 2004
First Named Inventor	Allan Charles Webb et al.
Examiner Name	Lenard A. Footland
Art Unit	3682
Attorney Docket No.	626220510021

METHOD OF PAYMENT (check all that apply)

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FEE CALCULATION (All the fees below are due upon filing or may be subject to a surcharge.)

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

	FILING FEES		SEARCH FEES		EXAMINATION FEES		
		Small Entity		Small Entity		Small Entity	
Application Type	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fees Paid ($)
Utility	300	150	500	250	200	100	
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	Fee ($)	Small Entity Fee ($)
Each claim over 20 (including Reissues)	50	25
Each independent claim over 3 (including Reissues)	200	100
Multiple dependent claims	360	180

Total Claims		Extra Claims		Fee ($)		Fee Paid ($)
_____	- 20 or HP =	_____	x	_____	=	_____

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims		Extra Claims		Fee ($)		Fee Paid ($)
_____	- 3 or HP =	_____	x	_____	=	_____

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims

Fee ($)	Fee Paid ($)
_____	_____

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets		Extra Sheets		Number of each additional 50 or fraction thereof		Fee ($)		Fee Paid ($)
_____	- 100 =	_____	/ 50 =	_____	(round **up** to a whole number) x	_____	=	_____

4. OTHER FEE(S)

	Fees Paid ($)
Non-English Specification, $130 fee (no small entity discount)	_____
Other (e.g., late filing surcharge): _____	_____

SUBMITTED BY

Signature	H Duane Switzer	Registration No. (Attorney/Agent) 22431	Telephone 216-586-7283
Name (Print/Type)	H. Duane Switzer		Date March 27, 2006

This collection of information is required by 37 CFR 1.136. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPEAL BRIEF

Mail Stop Appeal Brief - Patents
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Alexandria, VA 22313-1450

Sir:

This is appellant's brief on appeal from the Rejection dated October 31, 2005.

03/29/2006 MBIZUNES 00000065 501432 10784459
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Adjustment date: 03/30/2006 MBIZUNES
03/29/2006 MBIZUNES 00000065 501432 10784459
01 FC:1401 -500.00 CR

03/30/2006 MBIZUNES 00000004 501432 10784459
01 FC:1402 500.00 DA

TABLE OF CONTENTS

REAL PARTY IN INTEREST

This application is assigned to The Timken Company, by virtue of an assignment recorded in the U. S. Patent and Trademark Office on December 23, 1999, on Reel 010779, Frame 0212.

RELATED APPEAL AND INTERFERENCE

There are no appeals or interferences known to appellants, to appellant's legal representatives or to appellant's assignee which will directly affect, or be directly affected by, or have a bearing on, the Board's Decision in the pending appeal.

STATUS OF CLAIMS

The claims on appeal are claims 61-76, 80 and 81.

There are 21 claims pending in the application, namely, claims 61-81.

Claims 77-79 are allowed.

Claims 1-60 have been cancelled.

Claims 61-76, 80 and 81 are rejected under 35 U.S.C. §112, ¶s 1 and 2.

Claims 61-76, 80 and 81 are rejected under 35 U.S.C. §102(e) on U. S. Patent No. 5,490,732.

STATUS OF AMENDMENTS

There are no outstanding amendments.

SUMMARY OF CLAIMED SUBJECT MATTER

References to the specification and drawing in this Brief are to the amended specification and drawing as amended by the preliminary amendment filed February 23, 2004.

The claimed subject matter relates to the shape of a formed end on a spindle. The formed end holds a component on the spindle for rotation therewith. See the formed end generally indicated at 20 in FIGS. 1 and 3. The claims on appeal are similar to originally filed claims 20 and 47-51.

It is common to deform a spindle end portion axially and radially to retain a component on the spindle for rotation therewith. Excessive working of the metal can produce cracks in the formed end and otherwise reduce the strength of the formed end so that it will not be able to withstand the forces to which it is subjected during normal operation of the spindle and component. The use of excessive force when deforming a spindle end portion may distort the component, and result in improper operation or early failure.

The formed end of the present application minimizes the possibility that the formed end will crack or fracture. See page 9 lines 16-18, page 12 lines 25-28, and page 13 lines 1 and 2. The formed end of the present application also minimizes the possibility that the component that is held on the spindle will be distorted. See page 14 lines 10-19.

The preform geometry of the spindle end portion prior to axial and radial deformation thereof into a formed end is important for producing a good formed end without distorting the component. See page 14 lines 14-19 and page 15 lines 6-8.

FIG. 1 shows a spindle 14 received through an opening 27 in a component 26. The end portion of the spindle 14 that extends beyond the opening 27 is deformed axially and

radially into a formed end 20 that engages an outer face 32 of the component 26 and holds the component on the spindle for rotation therewith.

FIG. 3 shows the formed end 20 on the spindle 14 engaging the outer face 32 of the component 26. FIG. 4 shows the configuration of the spindle end portion prior to axial and radial deformation thereof into the formed end 20 of FIG. 3.

Examples of the claimed configurations are shown in FIGS. 3 and 4, and are best described in the amended paragraphs to pages 5, 6, 8, 9 and 14 of the specification in the preliminary amendment filed February 23, 2004.

With reference to FIG. 4, the spindle 14 has an inner bore 22, and a preform 70 with a deformable annular end portion 71. A first beveled surface 68 extends outward away from the bore and away from the longitudinal axis of the spindle 14. The first beveled surface 68 merges into a slightly tapered surface 72 at an intersection C. The slightly tapered surface 72 merges into another tapered surface 74 that leads away from the bore 22 at a greater angle than the slightly tapered surface 72.

The steeper tapered surface 74 leads out to a flat end surface 78 with which it merges at a curved surface 80. The flat end surface 78 at its periphery has a chamfer 82. Thus, the deformable annular end portion 71 has a cylindrical outer surface 71a and a tapered inner surface 72, 74 that tapers outwardly away from the spindle rotational axis toward the outer end 78 so that the deformable annular end portion 71 decreases in radial thickness along its length from its intersection C with the inner beveled surface 68 in a direction toward its outer end 78.

The preform shape of FIG. 4 is deformed and worked into the formed end 20 of FIG. 3. The deformable annular end portion 71 is deformed generally radially outwardly and

axially to have its outer cylindrical surface 71a become the inner end face 58 of the formed end 20. The inner end face 58 of the formed end 20 in FIG. 3 engages the outer end face 32 of the component 26.

Deformable annular end portion 71 in FIG. 4 is worked and deformed generally radially outwardly and axially so that both its outer end 78 and at least a portion of its tapered inner surface 72, 74 are worked and reformed into a single curved outside end surface 60 on formed end 20 in FIG. 3. See Figs. 7A - 7C and page 13 lines 3 - 17.

The curved outside end surface on formed end 20 faces outwardly generally axially of the spindle axis and curves smoothly along its entire length toward the spindle rotational axis from the peripheral outside corner 64 that is located closely adjacent the outer end face 32 of the component 26. The peripheral outside corner 64 is relatively sharp, yet curved. See lines 13 - 15 on page 8.

The curved outer end surface 60 on the formed end 20 curves from the peripheral outside corner of the formed end 20 adjacent the outer end face 32 of the component 26 in directions both axially outwardly and radially inwardly toward the spindle rotational axis so that a point traveling along the curved outer surface 60 moves both axially outwardly away from the component end face 32 and radially inwardly toward the spindle rotational axis. Thus, the thickness of the formed end 20 in a direction axially of the spindle rotational axis gradually increases along its length generally radially of the spindle rotational axis in a direction from the peripheral outside corner 64 closely adjacent the outer end face 32 of the component toward the spindle rotational axis. The curved outside end surface 60 merges into a generally flat outside end surface 62.

The inner face 58 of the formed end 20 merges with the outer surface 15 of the spindle along an inside corner 56, and the outside surface 60, 62, 66 of the formed end 20 merges with the spindle inner beveled surface 68 at an outside intersection C. The diagonal thickness of the formed end in a direction generally diagonally across the inside corner 56 and the outside intersection C is not less than the radial thickness (between 72, 74 and 71a) of the spindle deformable annular end portion 71 at any location along its length from C to 78.

The diagonal thickness of the formed end 20 in a direction generally diagonally across the inside corner 56 and the outside intersection C is not less than the axial thickness of the formed end 20 at a location that is in alignment with the interface 15, 27 between the cylindrical opening 27 in the component 26 and the spindle outer surface 15.

The outside transition 66, 68 between the spindle inside surface 22 and the axially facing outside surface 60, 62 of the formed end is shaped and configured to cut generally diagonally across between the internal surface 22 and the outside surface 60, 62. The outside transition 66, 68 is shaped and configured other than as a continuous smooth curve or as a right angle while including at least one generally plane surface 66 or 68 that is inclined outwardly from the spindle inner surface 22. The outside transition also is closer to the inside corner 56 than would be an outside transition formed by a continuous outwardly convex smooth curve tangent to the outside surface 60, 62 to provide the formed end with a reduced thickness in a direction generally diagonally across the inside corner 56 and the outside transition 66, 68.

GROUNDS OF REJECTON TO BE REVIEWED ON APPEAL

The rejections are as follows:

"Claims(s) 61-76 and 80-81 are rejected under 35 U.S.C. §112, first and/or second paragraphs, as the claimed invention is not described in such full, clear, concise and exact terms as to enable any person skilled in the art to make and use the same, and/or for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

These claims calling overall for a final product with a 'formed end' include commingled replete therein limitations regarding a 'preform' that in many cases makes confused and unclear what actual limitations of the final product are being claimed. For example, claim 61 has the deformable end portion decreasing toward its outer end (note also that claiming in parentheses [between ...] is not permissible); claim 70 has the end portion decreasing in thickness also; and claim 80 has the same. All claims should be reviewed to be purged of all reference to the preform."

"Claim(s) 61-76, 80-81, to the extent understood are rejected under 35 U.S.C. § 102(e), as being anticipated by Hofmann et al. ('Hofmann').

Hofmann disclose all of the claimed elements, as understood, including, for example, an "inner beveled edge" near beta of the front fig., and the 'deformable end portion' having a cylindrical outer surface and an 'inner [vertical] face'."

The Hofmann et al patent referred to in the rejection is U. S. Patent No. 5,490,732.

ARGUMENT

Principal Issues

A principal issue is whether claims 61-76, 80 and 81 fail to comply with 35 U.S.C. §112, ¶s 1 and 2.

Another principal issue is whether claims 61-76, 80 and 81 are anticipated under 35 U.S.C. §102(e) by U. S. Patent No. 5,490,732 to Hofmann et al.

The Rejection Under 35 U.S.C. §112,¶s 1 and 2

The rejection under 35 U.S.C. ¶112, ¶1 is not understood . The rejection provides that "the claimed invention is not described in such full, clear, concise and exact terms as to enable any person skilled in the art to make and use the same." The Examiner does not explain the deficiencies in the specification that support this rejection, and provides no reasons why the specification is defective.

This application is a continuation of the following granted U.S. Patents: 6,443,622; 6,640,438; 6,688,773; and 6,702,474. This application also contains allowed claims 77 - 79. The adequacy of the disclosure under 35 U.S.C. §112, ¶1 has never been questioned.

Rejections under 35 U.S.C. §112, ¶1 are discussed in MPEP §2161 - 2165.04, and in MPEP §706.03(c). Rejections under 35 U.S.C. §112, ¶1 relate to the Description Requirement, Enablement, Scope of Enablement, Best Mode Requirement, and Essential Subject Matter Missing From Claims. None of these apply to the claims of the present application, and the rejection under 35 U.S.C. §112, ¶1 is inappropriate.

Claims 61 and 62 include both reference numerals and words in parenthesis for explaining a claim recitation. The fifth subparagraph of claim 61 recites the annular end portion 71 in FIG. 4 as decreasing in radial thickness along its length, and includes the explanation "(between outer surface 71a and inner surface 72, 74)." Claim 62 recites the diagonal thickness of the formed end 20 in FIG. 3 between inside corner 56 and outside intersection C, and includes the explanation "(between 56 and C)." The Examiner indicates that "claiming in parenthesis [between ...] is not permissible."

Reference numerals were added to the claims in response to repeated rejections under 35 U.S.C. §112 on grounds that the claims could not be understood. This is permitted by MPEP §608.01(m) with the understanding that the use of reference characters in the claims is to be considered as having no effect on the scope of the claims. The Examiner does not object to the reference characters, but to the explanatory material in parenthesis that includes both words and reference characters.

While the use of both text and reference numerals in parenthesis may give rise to a lack of clarity objection, such is not the case here. No person of ordinary skill in the art could possibly believe that the objectionable items are part of the claim instead of mere explanatory material just like all of the other numerals in parenthesis. The objectionable material was added to the claims to assist the Examiner in understanding what is being claimed, and to overcome his rejections on grounds that the claims were not understandable. There is nothing wrong with the objectionable items that simply make it more clear as to what is being claimed, and the rejection under 35 U.S.C. §112 with respect to including both text and numerals as explanatory material in parenthesis in a claim is without merit.

The claims also are rejected under 35 U.S.C. §112 on grounds that recitation of features of the preform shape in FIG. 4 make the claims confused and unclear. The Examiner indicates that all reference to the preform should be purged from the claims.

It is plain that the claims are directed to a formed end. The preamble of claims 61 and 80 recite the combination of a spindle having a component secured thereto by a formed end. Claim 70 recites an assembly wherein a component is secured on a spindle by a formed end. All of these claims also recite the final shape of the formed end that secures the component on the spindle. That the claims also recite the preform configuration is not grounds for rejection under 35 U.S.C. §112, ¶2. There is nothing indefinite or unclear about claiming both final and original configurations of a spindle end portion that is deformed into a formed end. The original or preform configuration of the deformable spindle end portion is important for producing a formed end that will not distort the component that is secured on the spindle, and that will not fracture or develop cracks.

It has long been acceptable practice in this art to claim both final and original configurations of a deformed spindle end portion. The same Examiner that is examining the present application also examined U. S. Patent No. 6,113,279 granted March 30, 1998, to Sawai et al. Subparagraphs 7 and 8 of claims 1, 3 and 4, and subparagraphs 8 and 9 of claim 5, recite the preform shape and how it is deformed to produce the caulked portion (the formed end). These are the same type of recitations that the Examiner is objecting to in the present application.

U.S. Patent No. 5,490,732 to Hofmann et al., the reference applied against the claims of the present application, includes claims 4 and 5 that recite the configuration of the spindle before it is deformed. It is not acceptable to use the well-worn excuse that mistakes that were made in the past do not justify continuation of the same type of mistakes. The fact is that

there was no mistake, and claiming a final shape while also reciting the beginning shape is perfectly proper and has long been accepted in this art by the U.S. Patent and Trademark Office. The rejection under 35 U.S.C. §112 improperly bears on the validity of allowed claims 77 - 79 in this application and of the claims in granted U.S. Patent Nos. 6,443,622 and 6,702,474, some of which include recitations of the spindle configuration before it is deformed.

That the claims also recite features of the preform does not render the claims unclear or indefinite. The claims are perfectly understandable when read by using the reference numerals in the claims to refer to FIGS. 3 and 4 of the drawing. The claims recite characteristics of a formed end that is produced by starting with a preform having certain characteristics. There is no basis for the Examiner's requirement that all recitations to the preform be stricken from the claims. The rejection under 35 U.S.C. §112, ¶s 1 and 2 is without merit and should be reversed.

The Rejection Under 35 U.S.C. §102(e)

U. S. Patent No. 5,490,732 to Hofmann et al discloses a formed end on a spindle for holding a component on the spindle. The outer periphery of the formed end or bead 9 includes an inner sharp corner engaging an end face of the component 3 and an outer sharp corner adjacent the angle alpha. The radial outer end of the formed end 9 bulges outwardly between the inside and outside corners, and the outer corner is spaced farther away from the spindle axis than the inside corner.

The Hoffmann et al patent refers to a hub barrel 10 in lines 7, 19 and 23 of column 3. The barrel of the hub also is referred to in lines 46 - 48, 52, 54 and 67 of column 1, and in line 10 of column 2. There is no numeral 10 in the drawing. However, from the

description in lines 48 and 49 of column 1, and lines 1 - 3 of column 2, it is apparent that the "barrel" is the part of the hub 1 that is deformed into the formed end or bead 9.

Line 13 of column 2 indicates that the dimension S is the thickness of the barrel that is to be deformed. It is plain from Fig. 3 that dimension S is misplaced, and should be placed above its present location so that it would indicate the thickness of the barrel before it is deformed into the bead or formed end 9. There is no suggestion whatsoever that the original shape of the barrel includes a tapered inner surface. In fact, the only suggestion is that the original shape of the barrel includes parallel cylindrical inner and outer surfaces, and a uniform thickness S along its entire length as indicated by the shadow lines in Fig. 3. The outer portion of the bead or formed end 9 is thinner because it is on a much larger circumference than the circumference prior to outward deformation thereof.

The Claims

Claim 61

The claim recites the peripheral outside corner 64 of the formed end as being located closely adjacent the outer face 32 of the component 26. Hofmann et al has two peripheral corners, an inside corner located closely adjacent the end face of the component 3, and an outer corner that is spaced a significant distance axially outwardly from the component end face and not located closely adjacent the end face of the component as claimed.

The claim recites the curved outside surface 60 of the formed end 20 as being continuously curved from the peripheral outside corner 64 so that a point traveling along the curved outside surface 60 moves both radially inwardly of the spindle axis and axially outwardly. The formed end 9 in Hofmann et al has its end portion extending radially outwardly

of the spindle axis along the bulged end portion when proceeding from the inner corner of the formed end outer periphery rather than radially inwardly as claimed.

The claim recites the spindle as having an inclined inner beveled surface 68, a tapered inner surface 72, 74 and an outer end 78. The claim recites the spindle as being deformed so that its outer end 78 and at least a portion of its tapered inner surface 72, 74 are formed into a single curved outside surface 60 on the formed end 20. Hofmann et al has a radial surface adjacent the lead line for numeral 9' rather than an inclined beveled surface 68 as claimed. Hofmann et al does not disclose a tapered inner surface on the spindle deformable end portion , and does not disclose deformation of the spindle end portion so that its outer end and at least a portion of the inner surface are formed into a single curved outside surface as claimed. The outer end of the spindle in Hofmann et al simply is bulged outwardly and does not become a part of the outer surface of the formed end.

Claim 70

This claim recites the inclined inner beveled surface 68; the tapered inner surface 72,74; the intersection C between the beveled surface and the tapered inner surface; the intersection of the formed end outer surface 60, 62, 66 with the intersection C; the location of the intersection C diagonally opposite from the inside corner 56 of the formed end; the peripheral outside corner 64 of the formed end located closely adjacent the outer face 32 of the component; and the shape of the outside surface of the formed end 20 from the peripheral outside corner 64 toward the spindle axis. It is plain that Hofmann et al does not disclose these claimed features.

Claims 62 and 71

The claims recite the formed end as merging with the spindle outer surface at an inside corner 56, and the outside surface 60, 62, 66 of the formed end as merging with the spindle inner beveled surface 68 at an outside intersection. The outside surface of the formed end in Hofmann et al does not merge with any inner beveled surface.

Claims 63, 69 and 81

The claims recite the intersection C between the spindle inclined inner beveled surface 68 and the outside surface 60, 62, 66 of the formed end 20 as being located generally diagonally opposite from the inside corner 58. The continuation of the outside surface of the formed end in Hofmann et al intersects the radial surface adjacent the lead line for numeral 9' well inside the spindle bore and not diagonally opposite from the inside corner of the formed end as claimed.

Claims 64 and 72

The claims recite the deformable annular end portion 71 of the spindle 14 as being deformed along its length from adjacent the intersection C of the spindle inclined inner beveled surface with the tapered inner surface to its outer end 78. The Hoffman spindle barrel is not deformed from adjacent an intersection of an inner tapered surface with an inner beveled surface.

Claims 65 and 73

The claims recite the curved outside surface 60 of the formed end 20 as merging into a generally flat outside surface 62 that extends toward the spindle rotational axis X from the curved outside surface 60. Hofmann et al does not disclose the claimed flat outside surface.

Claims 66 and 75

The claims recite the diagonal thickness of the formed end diagonally between the inside corner 56 and the outside intersection C. Hofmann et al. does not disclose an outside intersection between a beveled surface and an outer surface of a formed end that is located diagonally across from an inside corner.

Claims 67 and 74

The claims recite the formed end as tapering to a relatively sharp rounded edge at its peripheral outside corner as disclosed in lines 13-15 of the originally filed specification. Hofmann et al. does not disclose such a peripheral outside corner on the formed end.

Claims 68 and 76

The claims recite the inner beveled surface 72,74 of the deformable spindle end portion 71 as intersecting the inclined inner beveled surface 68. The claims further recite the deformable end portion 71 as being deformed along its length from adjacent its intersection C with the inner beveled surface 68 to its outer end 78. The spindle end portion in Hofmann et al is not deformed along its length from adjacent its intersection with the radial surface near the lead line for numeral 9'. The beginning of the deformation in Hofmann et al is spaced a significant axial distance from the radial surface adjacent the lead line for numeral 9'.

Claim 80

The claim recites the spindle as having a deformable annular end portion 71 with a tapered inner surface 72, 74 that intersects an inclined inner beveled surface 68 that is inclined inwardly toward the spindle axis from the tapered inner surface. The tapered inner surface is

recited as tapering outwardly away from the spindle axis from its intersection C with the inclined inner beveled surface 68 toward the outer end 78 of the deformable end portion 71.

The claim recites the deformable annular end portion 71 as being deformed so that the tapered inner surface 72, 74 is outwardly deformed along its length from adjacent its intersection C with the inner beveled surface 68 to its outer end 78. Hofmann et al does not disclose a tapered inner surface on the deformable end portion of the spindle. Hofmann et al does not deform the spindle end portion along its length from adjacent the intersection with the spindle end portion inner surface with the radial surface near the lead line for numeral 9'. Hofmann et al does not disclose a formed end that minimizes the possibility of fracturing or developing cracks, and that minimizes the possibility of distorting the component that is secured on the spindle.

Respectfully submitted,

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CLAIMS APPENDIX

61. In combination:

a spindle (14) having a component (26) secured thereto by a formed end (20) that is formed by deformation of a deformable annular end portion (71) on the spindle;

the component having a cylindrical opening (27) therethrough and an outer face (32);

the spindle (14) having a spindle rotational axis (X FIG. 1), a spindle outer surface (15) and a deformable annular end portion (71) with an outer end (78);

the spindle (14) having an inner beveled surface (68) that is inclined inwardly toward the spindle rotational axis (X FIG. 1) from the deformable annular end portion (71);

the deformable annular end portion (71) having a cylindrical outer surface (71a) and a tapered inner surface (72, 74) that tapers outwardly away from the spindle rotational axis (X) toward the outer end (78) so that the deformable annular end portion (71) decreases in radial thickness (between outer surface 71a and inner surface 72, 74) along its length in a direction toward its outer end (78);

the deformable annular end portion (71) being received through the opening (27) in the component (26) and being deformed generally radially outwardly and axially into a formed end (20) that holds the component (26) on the spindle (14),

the deformation being such that the cylindrical outer surface (71a) of the deformable annular end portion (71) becomes an inner face (58) of the formed end (20) that extends outwardly of the spindle rotational axis (X) in engagement with the outer face (32) of the component (26),

the deformation further being such that the formed end (20) has a peripheral outside corner (64) located closely adjacent the outer face (32) of the component (26);

the deformable annular end portion (71) being deformed and worked so that both the outer end (78) and at least a portion of the tapered inner surface (72, 74) of the deformable annular end portion (71) are formed into a single curved outside surface (60) on the formed end (20) that faces outwardly generally axially of the spindle axis and curves smoothly along its length toward the spindle rotational axis (X) from the peripheral outside corner (64) of the formed end (20) that is located closely adjacent the outer face (32) of the component (26);

the curved outside surface (60) on the formed end (20) being continuously curved from the peripheral outside corner (64) of the formed end (20) adjacent the outer face (32) of the component (26) so that a point traveling along the curved outside surface (60) moves both axially outwardly and radially inwardly of the spindle axis and the thickness of the formed end (20) in a direction axially of the spindle rotational axis gradually increases along its length generally radially of the spindle axis in a direction from the peripheral outside corner (64) of the formed end (20) toward the spindle rotational axis (X).

62. The combination of claim 61 wherein the inner face (58) of the formed end (20) merges with the spindle outer surface (15) along an inside corner (56) and the outside surface (60, 62, 66) of the formed end (20) merges with the spindle inner beveled surface (68) at an outside intersection (C),

and the diagonal thickness of the formed end (between 56 and C) in a direction generally diagonally across the inside corner (56) and the outside intersection (C) is not less than

the radial thickness (between 72, 74 and 71a) of the spindle deformable annular end portion (71) at any location along its length (from C to 78).

63. The combination of claim 62 wherein the intersection (C) between the spindle inner beveled surface (68) and the outside surface (60, 62, 66) of the formed end (20) is located generally diagonally opposite from the inside corner (56).

64. The combination of claim 61 wherein the deformable annular end portion (71) is outwardly deformed along its length from adjacent the intersection (C) of the spindle inner beveled surface (68) with the tapered inner surface (72) of the deformable annular end portion (71) to the outer end (78) of the deformable annular end portion (71).

65. The combination of claim 61 wherein the curved outside surface (60) of the formed end (20) merges into a generally flat outside surface (62) that extends toward the spindle rotational axis (X) from the curved outside surface (60).

66. The combination of claim 61 wherein the diagonal thickness of the formed end in a direction generally diagonally across the inside corner and the outside intersection (between 56 and C) is not less than the axial thickness of the formed end (20) at a location that is in alignment with the interface (15, 27) between the component cylindrical opening (27) and the spindle outer surface (15).

67. The combination of claim 61 wherein the formed end (20) tapers to a relatively sharp rounded edge at said peripheral outside corner thereof (64).

68. The combination of claim 61 wherein the tapered inner surface (72, 74) of the deformable annular end portion (71) intersects the inner beveled surface (68),

the outward deformation of the deformable annular end portion (71) to produce the formed end (20) being such that the tapered inner surface (72, 74) of the deformable annular end portion (71) is outwardly deformed along its length from adjacent its intersection (C) with the inner beveled surface (68) to its outer end (78).

69. The combination of claim 68 wherein the intersection (C) between said tapered inner surface (72) and said inner beveled surface (68) of the deformable annular end portion (71) is generally diagonally opposite from said inside corner (56) after deformation of the deformable annular end portion (71) into the formed end (20).

70. In an assembly wherein a component (26) is secured on a spindle (14) by a formed end (20) that is formed by deformation of a deformable spindle annular end portion (71);

the spindle (14) having a spindle rotational axis (X FIG. 1), a spindle outer surface (15) and a deformable annular end portion (71) with an outer end (78);

the spindle (14) having an inner beveled surface (68) that is inclined inwardly toward the spindle rotational axis (X) from the deformable annular end portion (71);

the deformable annular end portion (71) having a cylindrical outer surface (71a) and a tapered inner surface (72, 74) that tapers outwardly away from the spindle rotational axis

(X) toward the outer end (78) so that the deformable annular end portion (71) decreases in radial thickness (between 71a and 72, 74) along its length in a direction toward its outer end;

the component (26) having an opening (27) in which the spindle (14) is received for rotation of the component with the spindle;

the spindle deformable annular end portion (71) being deformed generally radially outwardly and axially into a formed end (20) that engages an outer face (32) of the component (26) to secure the component (26) on the spindle (14);

the formed end (20) extending outwardly of the spindle axis and terminating in a peripheral outside corner (64) located closely adjacent the outer face (32) of the component (26);

the deformable annular end portion (71) of the spindle (14) being deformed and worked so that both the outer end (78) and at least a portion of the tapered inner surface (72, 74) of the deformable annular end portion (71) are formed into a single continuously curved outside surface (60) on the formed end (20) that curves smoothly along its length toward the spindle rotational axis (X) from the peripheral outside corner (64) of the formed end (20) that is located closely adjacent the outer face (32) of the component (26);

the formed end (20) having an inside face (58) that engages the end face (32) of the component (26) and merges into the outer cylindrical spindle surface (15) along an inside corner (56);

the formed end (20) having a generally axially facing outside surface (60, 62, 66) that merges with the spindle inner beveled surface (68) at an outside intersection (C); and

the intersection (C) between the outside surface (60, 62, 66) and the spindle inner beveled surface (68) being located generally diagonally opposite from the inside corner (56).

71. The combination of claim 70 wherein the diagonal thickness of the formed end in a direction generally diagonally across the inside corner (56) and the intersection of the spindle inner beveled surface (68) with the outside intersection (C) is not less than the radial thickness (between 71a and 72, 74) of the spindle deformable annular end portion (20) at any location along its length (from C to 78).

72. The combination of claim 70 wherein the tapered inner surface (72, 74) of deformable annular end portion (71) is outwardly deformed along its length from adjacent the intersection (C) of the spindle inner beveled surface (68) with the tapered inner surface (72, 74) of the deformable annular end portion (71) to the outer end (78) of the deformable annular end portion (71).

73. The combination of claim 70 wherein the curved outside surface (60) of the formed end (20) merges into a generally flat outside surface (62) that extends toward the spindle rotational axis (X) from the curved outside surface (60).

74. The combination of claim 70 wherein the formed end (20) tapers to a relatively sharp rounded edge at said peripheral outside corner (64) thereof.

75. The combination of claim 70 wherein the diagonal thickness of the formed end in a direction generally diagonally across the inside corner (56) and the intersection of the spindle inner beveled surface (68) with the outside intersection (C) is not less than the axial thickness (between 58 and 62) of the formed end (20) at a location in alignment with the interface

(between 15 and 27) between the cylindrical opening (27) in the component (26) and the spindle outer surface (15).

76. The combination of claim 70 wherein the tapered inner surface (72, 74) of the deformable annular end portion (71) intersects the inner beveled surface (68),

the outward deformation of the deformable annular end portion (71) being such that the tapered inner surface (72, 74) of the deformable annular end portion (71) is outwardly deformed along its length from adjacent its intersection (C) with the inner beveled surface (68) to its outer end (78).

80. In combination:

a spindle (14) having a component (26) secured thereto by a formed end (20) that is formed by deformation of a deformable annular end portion (71) on the spindle (14);

the component (26) having a cylindrical opening (27) therethrough and an outer face (32);

the spindle (14) having a spindle rotational axis (X FIG. 1), a spindle outer surface (15) and a deformable annular end portion (71) with an outer end (78);

the spindle (14) having an inner beveled surface (68) that is inclined inwardly toward the spindle rotational axis (X) from the deformable annular end portion (71);

the deformable annular end portion (71) having a cylindrical outer surface (71a) and a tapered inner surface (72, 74) that intersects (C) the inner beveled surface (68);

the tapered inner surface (72, 74) tapering outwardly away from the spindle rotational axis (X) from its intersection (C) with the inner beveled surface (68) in a direction

toward the outer end (78) so that the deformable annular end portion (71) decreases in radial thickness (between 71a and 72, 74) along its length in a direction toward its outer end (78);

the deformable annular end portion (71) being received through the opening (27) in the component (26) and being deformed generally radially outwardly and axially into a formed end (20) that holds the component (26) on the spindle (14),

the deformation being such that the cylindrical outer surface (71a) of the deformable annular end portion (71) becomes an inner face (58) of the formed end (20) that extends outwardly of the spindle rotational axis (X) in engagement with the outer face (32) of the component (26); and

the tapered inner surface (72, 74) of the deformable annular end portion (71) being outwardly deformed along its length from adjacent its intersection (C) with the inner beveled surface (68) to its outer end (78).

81. The combination of claim 80 wherein the inner face (58) of the formed end (20) merges with the spindle outer surface (15) along an inside corner (56),

and the intersection (C) between the outer surface (60, 62, 66) of the formed end (20) and said inner beveled surface (68) is located generally diagonally opposite from said inside corner (56).

Evidence Appendix

None

Related Proceedings Appendix

None